

AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraph beginning on page 4, line 3, as follows:

In order to apply a ferromagnetic tunnel junction element to a high-density magnetic recording head, it is desirable in this manner that one of the ferromagnetic materials have a spin-valve structure with exchange bias applied thereto. The anti-ferromagnetic material used therein not only must have thermal stability that does not hinder device operation, but also must have a high resistance to corrosion in the device fabrication process. In the above-noted reports, however, when low-blocking-temperature of FeMn (blocking temperature ~~150eC~~ 150°C) and NiO (blocking temperature ~~200eC~~ 200°C) are used, the thermal stability is insufficient.

Please amend the paragraph beginning on page 5, line 1, as follows:

Mn regular alloys of PtMn, PdMn, and NiMn are anti-ferromagnetic materials having a high blocking temperature of ~~300eC~~ 300°C or greater. An anti-ferromagnetic material made of these Mn regular alloys has superior thermal stability due to its high blocking temperature, and also has good corrosion resistance, making this material extremely advantageous when a ferromagnetic tunnel junction element is applied to a device such as a magnetic head.

Please amend the paragraph beginning on page 5, line 15, as follows:

Therefore, in order to regularize the chaotic phase so that a proper exchange coupling magnetic field is achieved, it is necessary to perform thermal processing in a magnetic field for a long period of time at a higher temperature than in the past (~~250°C~~ 250°C for PtMn, ~~230°C~~ 230°C for PdMn, and ~~270°C~~ 270°C or higher for NiMn, for a period of approximately 5 hours).

Please amend the paragraph beginning on page 9, line 10, as follows:

In the present invention, by laminating neighboring ferromagnetic layers onto the lower layer, there is an improvement in the layer structure of the spin tunnel magnetoresistive effect film, and it becomes possible to achieve a large magnetoresistive change ratio. The average surface roughness of the anti-ferromagnetic layer is improved by using Ta, ~~Hf~~ Hf, Zr, or an alloy thereof in the lower layer, and it is particularly desirable that this be in the range from 0.1 to 5 Angstroms. In the case in which the average surface roughness exceeds 5 Angstroms, the surface roughness in the boundary layer of the magnetic thin film or the like that is laminate thereover increases, and there is a worsening of the uniformity of the film thickness of the tunnel barrier layer.

Please amend the paragraph beginning on page 9, line 25, as follows:

By keeping the average surface roughness of the anti-ferromagnetic layer in the range from 0.1 to 5 Angstroms, there is a clear boundary at the magnetic thin film or the like laminate thereover, and there is an improvement in deterioration of the tunnel barrier layer with thermal processing and the accompanying lowering of resistance change. In the present invention, the anti-ferromagnetic thin film and neighboring magnetic thin film laminated thereover are thermally processed at ~~200°C~~ 200°C to ~~300°C~~ 300°C in a magnetic field, thereby enabling the achievement of uniaxial anisotropy in the magnetic thin film.

Please amend the paragraph beginning on page 26, line 25, as follows:

A second magnetic thin film 6, which detects a magnetic field, and an upper electrode layer 7 are formed over the above structure. When this is done, the magnetic field applied during the film formation is rotated ~~90°~~ 90° during the film formation, so that the axis of easy magnetization of the first magnetic thin film 4 neighboring the anti-ferromagnetic thin film 2 and the axis of easy magnetization of the second magnetic thin film 6 neighboring thereto with an intervening tunnel barrier layer 5 are perpendicular to one another.

Please amend the paragraph beginning on page 27, line 6, as follows:

Next, the above-noted laminate is placed in a heating furnace and, as a DC magnetic field of 3 kOe to 20 kOe is applied to the easy magnetization direction of the exchange coupling layer, thermal processing is done at ~~200~~ 200°C to ~~300~~ 300°C, this becoming the spin tunnel magnetoresistive effect film.

Please amend the paragraph beginning on page 38, line 10, as follows:

The surface height unevenness shown in the drawing is that of the PtMn surface. The average surface height unevenness is smoothed by forming the PtMn film at a reduced substrate temperature, and there is a particular improvement in the flatness to better than 5 Angstroms at a temperature of below ~~0~~ 0°C.

Please amend the paragraph beginning on page 38, line 16, as follows:

The average surface height unevenness influences the average surface height unevenness of the CoFe film laminated thereover, and further of the Ru film, the CoFe thereover, and the NiFe thereover, thereby influencing the surface height unevenness of the tunnel barrier layer. For this reason, in order to control the surface height unevenness of the film, it is preferable when forming the CoFe/Ru/CoFe/NiFe films disposed beneath the tunnel barrier layer 5 that the temperature of the substrate be keep below ~~0~~ 0°C.

Please amend the paragraph beginning on page 38, line 26, as follows:

The result of keeping the substrate temperature below ~~0~~ 0°C in this manner even when forming the CoFe film over the PtMn was that the average surface height unevenness of the CoFe surface substantially the same as the average surface height unevenness of the PtMn shown in Fig. 12.